Designing for Children
- With focus on 'Play + Learn'

Biocultural Diversity and Sustainability Learning Curriculum for Maharashtra

Experiences from Maharashtra Gene Bank Project

Satish Awate, Centre for Environment Education, Pune, India, satish.awate@ceeindia.org,

Abstract: This paper describes experiences spread over 7 years of participatory designing and testing of biocultural diversity and sustainability learning curriculum under Maharashtra Gene Bank Project, offering learnings for more inclusive curriculum designing reflecting natural and cultural realities, aspirations and developmental & sustainability challenges. An ecosystem approach was followed to design curriculum in contexts of forests, grasslands, wetlands and bio-diverse agro-ecosystems in Maharashtra. Guided by the curriculum two learning methods of Shivar Feri – school-based neighbourhood exploration and bio-cultural diversity mapping, and Habitat linked Projects Based Learning were designed and tested. It was useful to overcome the 'instrumentality' approach towards children and focus upon 'action learning' linked to learners cultural and environmental contexts; though this 'blended approach', still requires facilitation from actors outside the school. Paper also discusses relationships between basic subject competencies and environment and sustainability learning, challenges of access to quality learning resources and market driven school project reality.

Key words: Biocultural diversity and sustainability learning, Curriculum, Maharashtra Gene Bank Project (MGB), Shivar Feri, Habitat linked Project Based Learning (H-PBL), Blended Learning, Education for Sustainable Development, Competencies, School Projects

1. Introduction

Maharashtra Gene Bank (2014-2020) was a conglomerate project supported by Rajiv Gandhi Science Technology Commission, Government of Maharashtra, which undertook community level action research towards conservation of biological

resources and strengthening community livelihoods, involving over 20 Community Based Organizations (CBOs), NGOs and Research Institutions. Centre for Environment Education (CEE), Pune was implementing project component 'Information Management, Education and Communication for Maharashtra Gene Bank Project'. This component was implemented with 14 partner organizations clustered under themes of 'Agro-biodiversity', 'Forest Eco-restoration', 'Grasslands Biodiversity' and 'Fresh water biodiversity'. 179 Schools from 16 clusters participated in this project with an approval from Directorates of Primary and Secondary Education, Government of Maharashtra.

This unique project where communities, organizations and research institutions came together at state level scale offered an opportunity to design a state contextualized curriculum for biodiversity education which until now was tried out as small localized projects or focussed on a Western Ghats landscape as largely extra-curricular activities and as a Non Formal Education – Formal Education partnerships. (Satish Awate and Dhondiba Kumbhar, 2013). Engaging students in 'environmental education' activities often gets narrowed down to 'instrumentality' of the students in collecting data or cleanliness drives or plantation activities. Further, a meaningful education about biodiversity and conservation need to recognize that environment, culture and language are intricately connected. This leads us in understanding the term bio-cultural diversity as 'the interlinked diversity of life in nature and culture, and about integrated whole formed by biodiversity, cultural diversity, and linguistic diversity. Diversity in this fuller sense is the multi-faceted expression of the creative force and potential of life in both nature and culture, a wellspring of vitality and resilience for life on the planet.' (Luisa Maffi and Ortixia Dilts, 2014).

This paper is an attempt to discuss the experiences of this recently concluded journey of last 7 years which saw experimenting with linking school-based learning to community based participatory conservation activities in learners' habitats. In tandem with community level action themes, 4 different curriculum frameworks were developed focussed on themes of agro-biodiversity, forests eco-restoration, grassland biodiversity and freshwater biodiversity. These frameworks guided the journey of designing learning activities and projects ideas, learning support materials, students-teachers hands on learning workshop modules, and testing of

Shivar Feri (neighbourhood walks and bio-cultural diversity documentation method) and habitat linked projects ideas bank. The process also included a baseline study on benchmarking pre-intervention level of information and understanding about natural elements among school children and teachers, prevailing reality of school projects topics, methods, materials used, costs and outcomes. Language used in this project including curriculum, learning resources and various studies was Marathi with conscious efforts to include regional variations. By its very nature bio-cultural learning process was multi-lingual, providing scope for bringing in learners cultural capital and mother tongues.

2. Methods

Curriculum designing process comprised of field visits and documentation of natural and cultural realities, school visits to understand realities of projects-based learning, consultative meetings with partner organizations teams to arrive at learning areas within each theme, a multi-stakeholder workshop on finalizing curriculum framework for field testing involving textbook designers, educators, biodiversity and communication experts.

Baseline study and school projects topics, materials, costs and outcomes study were done using A mix of questionnaire-based inquiry and identification test recordings. Study on food diversity among school children was done through self-reporting by students through participation in an activity 'what's all in my plate' and using interview method for 3 generations study.

Bio-cultural diversity learning projects were designed by CEE team and taken to the testing and choices and actual implementation data was collected through a combination of documentation by student-teacher teams from participating schools, school-based data collection by local educators from partner organizations and actual submissions of projects done to CEE. All the data was entered in Excel format for analysis using standard statistical methods.

3. Limitations

Since these studies were done opportunistically with the group of participant students and teachers creating limitations, while doing statistical analysis data normalization was followed keeping standard wise distribution across girls and boys equal and comparable. It was not possible to get same students who participated in baseline development studies through out 4 years, and later group contains mix of students who participated in baseline study and those who do not participated in it, but all went through the process of Shivar-feri and participated in Habitat linked

Projects Based Learning process. Sample sizes are mentioned wherever findings of data analysis are presented in the paper ahead.

4. Results

4.1. Curriculum framework

Curriculum framework for 4 themes included learnings areas common to all themes as presented in table below

No.	Themes	Learning Areas
1	Grassland Biodiversity	1. Theme/ecosystem and History 2. Understanding ecosystem, elements and interactions 3. Ecosystem and food & nutrition 4. Ecosystem and language, culture 5. Ecosystem management and conservation 6. Economic significance 7. Ecosystem and Gender 8. Ecosystem and Climate change 9. Ecosystem and governing policies and programmes
2	Agrobiodiversity	
3	Fresh Water Biodiversity	
4	Forests Biodiversity	

Table no. 1: Themes and Learning areas

Each learning area is typically organized as in the table below

	Theme: Agro-biodiversity		
	Learning Area: History of Agriculture and animal husbandry		
No.	Learning Objectives	Learning Activities	Standards
1	When How and where all agriculture began in the world	Reading stories and maps about origin of agriculture	5 to 12
2	Knowing different crops, their origin/domestication and journey	Play the game ‘Crops and their origin’	5 to 12
3	History and timeline of agriculture history in your village/Maharashtra	Young Historians: exploring history of our own habitat and creating a historical time line of agriculture	8 to 12

		Interview the elders and find out changes in crops and reasons behind it and what impact those changes had on their lives	8 to 12
4	Understanding agriculture – animal husbandry and linkages with festivals	Prepare calendar of festivals in your village	7 to 12
		Find out about seasons, crops, landscapes-waterscapes associated with these festivals	7 to 12
		Find out relationships of goddesses, womenfolk and agricultures	7 to 12
		Find out relationships of pastoral societies and agricultural societies through history, culture and present reality	7 to 12
		Document stories of local deities their festivals, special food offering and other materials. (such as *Waghjai*, *Sati Asara, Thaloba, Bhairoba, Mariaai, Kansari, Yahamogi)*	7 to 12
		Organize field food feast with village elders	7 to 12
		Document, listern, perform proverbs, *Ovi, Bharud, Bhalari* and other songs associated with sowing and harvests	1 to 10
		Reading/ listening story of genetic mutation that made it possible for adults to digest milk	7 to 12

Table no.2: Learning area, Learning Objectives and Activities with appropriate standards.

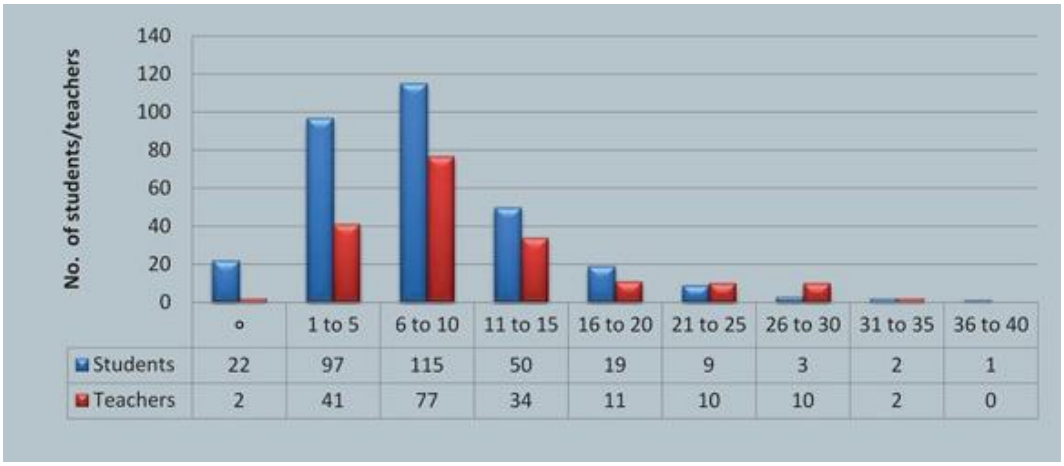
4.2. Baseline study on information and understanding about ecosystem elements

This study was done with 321 students and 187 teachers from 179 schools from 18 districts of the state. Some chose not to respond so actual sample size from this group for each dataset analyzed varied.

4.2.1. Number of trees recorded by students and teachers

As groups students and teachers recorded 183 and 180 respectively, unique names of trees. Together they recorded list of 257 unique names of trees. These need not necessarily number of tree species as same species is likely to have multiple local names, highlighting importance of photo documentation/herbarium development and arriving at standardized databank with botanical names and regional variations of them.

Individually majority of students and teachers fell within the bracket of 6 to 10 tree names with 36.2% and 41.2% respectively recording 6 to 10 tree names. Highest individual recording was done by a lone student in 36 to 40 names bracket.

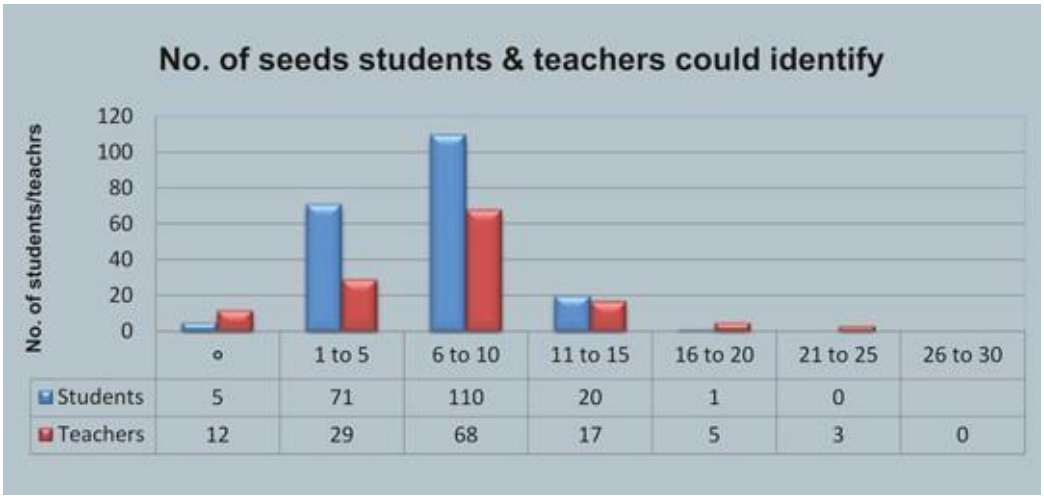


	0	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40
Students	22	97	115	50	19	9	3	2	1
Teachers	2	41	77	34	11	10	10	2	0

Diagram no. 1: distribution graph of students and teachers recording tree names

4.2.2. Seed identification

From a set of over 30 types of seeds of trees generally found in all parts of the state, 53.1% students and 50.7% teachers could recognize 6 to 10 species' seeds. Highest number of 21 to 25 seeds were identified only by teachers.

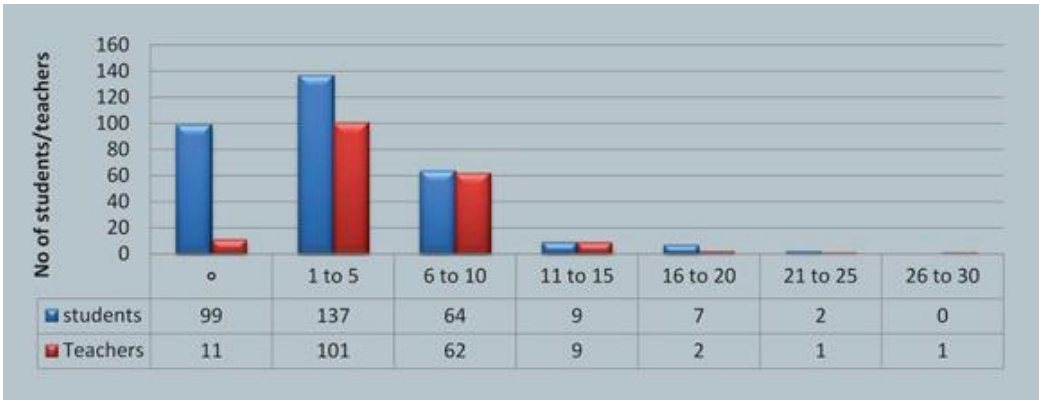


	0	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30
Students	5	71	110	20	1	0	
Teachers	12	29	68	17	5	3	0

Diagram no.2: Distribution graph of student's and teacher's ability to recognize seeds

4.2.3. Ranmeva: Non cultivated, ready to eat food

Non cultivated, ready to eat food items generally referred in Marathi as Ranmeva include plant derivatives such as fruits, tubers, resin as well as insect derived food such as honey. In this case 43.1% of students and 54 % of teachers could name 1 to 5 non cultivated food sources, while 20.1% students and 33.2% teachers recorded 6 to 10 names of Ranmeva. Two students recorded highest 21 names. As groups, students recorded total 91 unique names, while teachers recorded total 96 unique names of Ranmeva. Combined the list grows to 135 unique names, indicating scope for co-learning between students and teachers. This also emerged as a significant area for further research from food, nutrition and conservation point of view.



	0	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30
students	99	137	64	9	7	2	0
Teachers	11	101	62	9	2	1	1

Diagram no.3: Distribution of students and teachers based upon number of non-cultivated food sources they recorded

4.2.4. Birds I know

All together students group reported 142 and teachers group reported 140 unique bird names. Among the students, highest recorder recorded 22 bird names. While 67 bird names were common between students and teachers, but the list of exclusive names was over 70 unique names between both the groups.

4.2.5. Butterflies I know

Overwhelming majority of 72.7% students did not report any name of butterfly. 25.3 % were able to report 1 to 5 names and just 1.8% reported 6 to 10 names. Among teachers 64.6% did not report any name, 33.5% reported 1 to 5 names and 1.6% 6 to 10 names.

4.2.6. Fishes I know

Among students, 42.9% did not reported any fish name, 47.9% reported between 1 to 5 names, 6.8% reported 6 to 10 names and 2% reported 11 to 15 fish names. The figures for teachers were 19.5%, 54.8%, 21.8% and 4.3% respectively.

4.2.7. Situational questions

Out of 115 students and 156 teachers who responded, 66.9% students and 66% teachers chose 25% low yielding traditional variety against higher yielding hybrid variety. While as a group who chose traditional Jwari (sorghum millet) varieties were clearly able to report qualities like climate resistance, low water requirement, pest resistance, taste and nutritional superiority, low costs of inputs, good for soil health and good quality fodder. While the group which chose hybrid variety sighted reasons such as need to feed large population, low water requirement, higher yield in less space, low seed requirement, climate resilience as against local varieties. This indicating still existing large-scale awareness upon benefits of traditional varieties and typical misconceptions about hybrid seeds, and need for systems understanding about why traditional varieties have declined over time.

In response to another question on lower wages for women workers than male workers for same work, 83% students and 78% teachers opined that it was wrong to discriminate against women. While respondents were trying to form their opinions referring to their context and normative realities by ignoring the mention of same work in the question and attributing discrimination to men's ability to do heavy works, also sighted reason was women being less sincere in doing work and arrive late at work. A male student argued in his response that even if women arrive late at work, one should not ignore the fact that she has to attend to domestic chores for whole family including men.

4.2.8. Use of google earth

9% students and 33% of teachers and educators responded positively of using google earth. Upon further enquiry they were found to be confusing it with using google map in the smartphones.

4.2.9. Mathematical competence

Students and teachers were asked to describe method to calculate height of a tree without physically measuring it and calculate volume of rain water that could be potentially collected on a roof of a building given its length, width and rainfall data. For measuring tree height no one from students as well as teachers could

describe precise method using geometry. Only one teacher and no student could calculate the volume of rain water.

It turned out to be an exciting experience for teachers when method of measuring tree height was demonstrated to them later during the Anandshala shibir.

4.3. Shivarferi – neighborhood exploration and bio-cultural diversity mapping by schools

This method included exploration of neighborhood bio-cultural diversity at three different levels

4.3.1. Developing overview of bio-cultural diversity by talking to people as well as field observations using methods such as line transect and point observation. This helps create lists and photo documentation of different types of plants, animals, insects, mushrooms, crops and varieties, domestic animal breeds, wild food sources, cultural places and activities, personalities with knowledge and skills related to biodiversity and cultural practices.

4.3.2. Second level involved finding out interrelationships between different elements in ecosystems such as crop and birds, tree and different lifeforms associated with it, grassland and different uses by different communities and such. This is critical from learning point of view, especially finding interrelationships beyond obvious food and shelter relationships. An interesting example of which emerged from Fresh Water Biodiversity cluster with local community attributing a fish causing growth in rat population. It turned out to be an invasive puffer fish with spines causing death of snakes which in turn resulting into growth of rat population.

4.3.3. The third level involved selecting a topic of own interest individually or in a group and doing in-depth study using methods such as quadrat methods to find out diversity, dominance among grass species and potential of grass production on village grassland area and such. This level helps learners to apply various subject competencies and develop problem solving abilities.

4.4. Designing of Bio-cultural diversity learning support material kit

School level neighborhood exploration and documentation process was assisted with a generalized kit which can be used in all parts of the state and comprised 8 different resources viz.-

4.4.1. Insect Folder- Photographic field guide for crop wise 87 agricultural pests & 19 useful insects for 15 crops which are also crops selected for genetic diversity conservation under the larger MGB project.

4.4.2. Wild vegetables & tubers - a folder of 30 wild vegetables & 6 tubers, commonly used in Maharashtra with photographs, local name, botanical name, edible part, period of occurrence, Habitat, type, growth habit & use. It also provides guidelines for studying wild vegetables in one's habitat.

4.4.3. Birds - This pocket size bird field guide designed for beginners' use during neighborhood walks and contains 95 birds arranged ecosystem wise wetland, grassland – scrub, agricultural fields, forests, home/kitchen garden and also select endangered & rare ones.

4.4.4. Pocket booklet on snake focused on similar looking venomous and non-venomous species.

4.4.5. Butterfly & Moth - A pocket booklet contains 50 butterfly species from 5 families, with photograph, common name, scientific name, habitat, associated plant species & also 12 moth species.

4.4.6. Gecko & Lizards folder with 12 different species of gecko & lizards with photograph, common names in Marathi and English, scientific name & body length

4.4.7. Mushroom folder with 33 different species of mushrooms with photographs.

4.4.8. Frogs and Toads folder with 12 species.

4.4.9. A School Biodiversity Register for record keeping at school levels.

4.4.10. Cloth bag with MGB logo and graphics of Jwari (sorghum millet) varieties from Maharashtra viz. Dagadi, Kavali, Gidgyap, Maldandi, Dukari, Manthi and Pivali.

Above materials have been made available as PDF files for free downloading on www.gotul.org.in (During the course of the project, content designing for developing resource materials for schools on grasses and fishes was undertaken and is getting added to this kit)

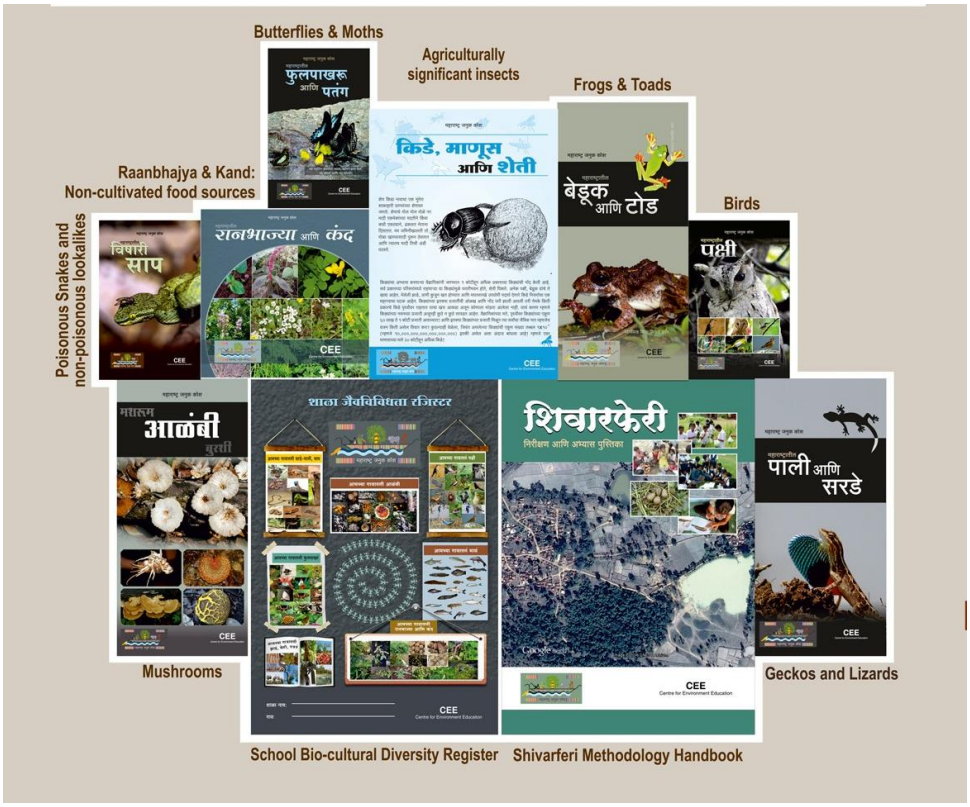


Photo 1: Bio-cultural diversity learning kit

4.5. Anand Shala Shibir – 3 days residential learning workshops

Three different modules of these workshops were developed focused on Shivar Feri (2016), Projects Based Learning method (2017) and Experience sharing of school and projects (2018). These workshops were organized in places offering thematic hands on learning scope in forest, grassland, wetland and agricultural fields and with local communities interacting with these ecosystems. Hands on learning activities were supported by interactive sessions including with local knowledgeable community members, audio-visual aides, games, and cultural activities including enjoying local foods.

Immediate feedback from students and teachers was overwhelmingly positive, with students demand to extend the duration of workshop to teachers terming it among the best training workshop of their carrier life. How much learning from these workshops they were able to implement as part curricular transactions continue to depend upon a range of factors at their personal level, at school as an institution and educational system realities.

4.6. Creation of 'Pitara' - common biodiversity learning resource

To support advance level of interest in bio-cultural diversity studies and documentation, a common resource was created in 16 clusters. To start with it included 21 elements – state of art field guides and references in English and

Marathi on trees, birds, mammals, reptiles, butterflies; water testing kit, soil testing kit, specially customized rocks and minerals kit, binoculars, cameras, weighing scales, measuring tapes and ropes, seed display kit, standard herbarium sheets, painting kit and first aid kit. Students and local groups extended this resource by adding samples of seeds, local rocks and soil samples and additional reading resources. The idea also is counting knowledgeable individuals from one's community as learning resource.

4.7. Habitat Linked Project based learning

After first Anandshala Shibir focused on Shivar Feri, while 99 schools reported conducting 158 Shivar Feri activities, registration of observations in a systematic way in School Biodiversity Register did not happened as expected, and it was realized that it required continuous follow ups and a system at school level which was not possible at the level of inputs and engagement with school management provided for under the project. With this learning second Anandshala Shibir was designed to bank upon existing systemic scope of mandated projects-based assessment till standard 8, under Continuous Comprehensive Evaluation (CCE) under Right to Education Act, 2009.

A project ideas bank with articulation of objectives, resources required and step by step methodology with tips on presentation and extension ideas was designed with a set of 13 project ideas as common across the themes and 45 theme focused project ideas. With hands on trials on projects during Anandshala Shibir (2017), students and teachers made a selection of projects of their interests and plan to work on those ideas, mainly in their class and wherever possible involving students from school at large. As part of their plans schools chose total 42 project ideas, and within a year they reported back with submissions of posters on 29 project ideas which students worked on. Below is a top 10 list of project ideas those were selected and actually worked on and reported by schools during Anandshala Shibir, 2018.

No.	Project ideas selected	Project ideas reported back
1	What's all in my plate	What's all in my plate
2	Making greeting cards using grass species	Domestic animal breeds
3	A day in a life of my mother and father	Rock and soil types in my village, A day in a life of my mother and father, How much children spend on

		packaged/processed food?
4	How much children spend on packaged/processed food?	Herbarium, Making greeting cards using grass species
5	Rock and soil types in my village	Study of fodder, Young Historian – History of my village, Tree and associated life forms, Diseases of domestic animals
6	Crops and pests	News article collage on organic farming, Grass studies using quadrat method, Crops and pests, wild vegetable festival in school
7	Diseases of domestic animals	Local festivals calendar, Bio-cultural map of village, Making Dashparni Ark (herbal pesticide and growth promoter), government schemes related to agriculture, My village, food festival and local recipes, Water Tank in my village, illustrated map of water tank, visit to fishing cooperative.
8	Domestic animal breeds	
9	Making Dashparni Ark (herbal pesticide and growth promoter), Photo story, Tree and associated life forms	
10	Study of fodder	

Table no.3: Top most project ideas selected and worked upon by students under this initiative

Students were able to engage in the process of constructing knowledge by way of observation, interactions, drawing, referring, measurements, creation, cooking, tasting, knitting, planting. These activities are helpful in developing Education for Sustainable Development (ESD)competencies in areas of recognizing, assessing and acting (Jörg Robert Schreiber and Hannes Siege, 2016).

Lack of age-appropriate basic competencies in areas of reading, writing and numeracy prove a limiting factor for developing complex competencies such as

integrative problem solving. At the same time projects-based learning about and linked to learners' bio-cultural realities helped learners develop basic competencies, since it allows learners to bring in their life experiences in to the learning process and using their first language. This contributes in creating a positive and enabling learning environment.

4.7.1. Prevailing reality of school projects in the state

As a collaborative research with partner organizations, 1192 students from standard 1 to 12 with varying numbers were interviewed from 16 districts to find out project topics, methods, materials, costs and to understand learning outcomes. Out of total sample size 35 boys and 35 girl students were randomly selected from standards 5th to 9th, making sample selected for analysis as 350 students.

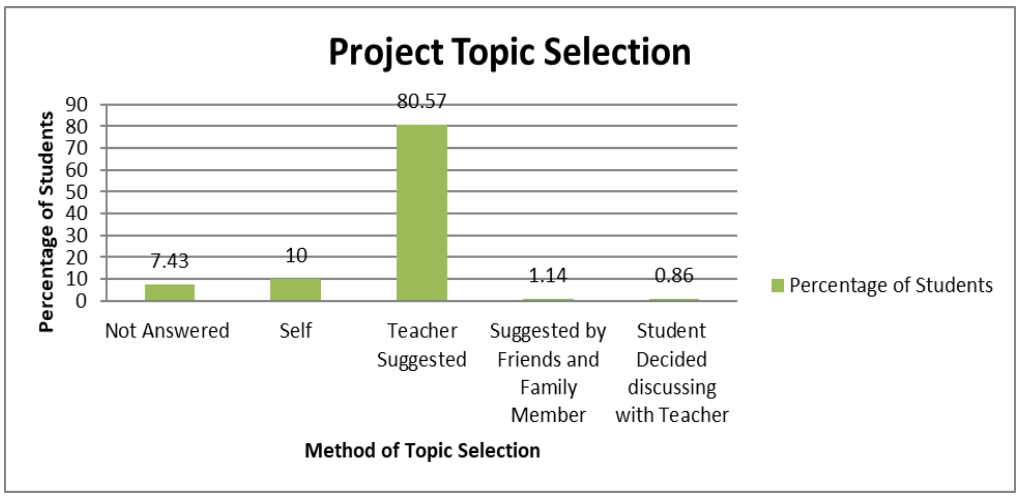


Diagram no.4

It is found that present methods of doing school projects is contrary to the constructivist methodology. These mostly prescribed and relied heavily on copying information from books to internet and pasting stickers.

List of most widely chosen project topics by students from standard 5 to 9, as per this study is as below

No.	Project topic
1	Information of great Leaders, Personalities, Men, Women, Scientist, Saints (and such)
2	Synonyms and Antonyms, Information about flowers and fruits
3	Pictures of leaders
4	Information of festivals, Idioms in Hindi and Marathi

5	Information about plants, collection of leaves, information of saints
6	Seed collection, Collection of quotes (good sayings)
7	Information of forts
8	Collection of information on birds, Collection of information on wild animals
9	Mathematical equations
10	Collection and reading of maps

Table no.4: Top 10 project topics as per prevailing practice in the state (std. 5 to 9)

No.	Marks as feedback to students	%
1	Marks were not told, did not remember, no response	42.57
2	Project was not evaluated for marks	1.43
3	Marks were known to students	56

Table no.5

It turned out to be largely a market driven activity with little quality control. A market survey and collection of sample materials from 10 districts could assess products ranging from project pages/booklet, charts to stationary items from 90 publications. Of these 14 mentioned their website address out of which 7 could not be found to exist. These materials come with varying degree of quality in terms of paper, printing and accuracy and appropriateness of content, with exotic elements and their names.

Out of 121 charts we reviewed, only 24 had Marathi names of elements along with Hindi, Gujarati and English. These charts were found to be printed in either Mumbai or outside Maharashtra.

Species depicted were exotic species. Wild species charts were found to contain mostly African animals. Exotic species dominated in fruits, vegetables, flowers, wild animals, domestic animals charts as well.

Example: Chart: Types of butterfly (chart no.102918): Incorrect title, Viceroy and Sulphur butterflies are from American continents. Other exotic species such as Cynthia moth, Small Emperor moth (Atlas).

Missing information, e.g. Butterfly (104317) Lifecycle stages not named, and illustrations are unclear) and Leaves 100535 - Palm leaves shown with no Marathi names.

Incorrect names/photographs such as Cicada mentioned as cricket, Insects (103957) where Dragonfly mentioned as Tol (locust) and Patang (moth), incorrect illustrations of locust with 2 legs, no application of scale – flea is bigger than honey bee and in chart, Fruits 110819 – inclusion of sugarcane as a fruit, and in Vegetables (100232), incorrect pictures given for palak, kohala (ash gourd). Diversity of names for single elements was missing, with only one exception found with two names, Sonde & Toke given for rice weevil. This is an important aspect in developing material for learners from different regional and language backgrounds.

Expenditure on school projects by students

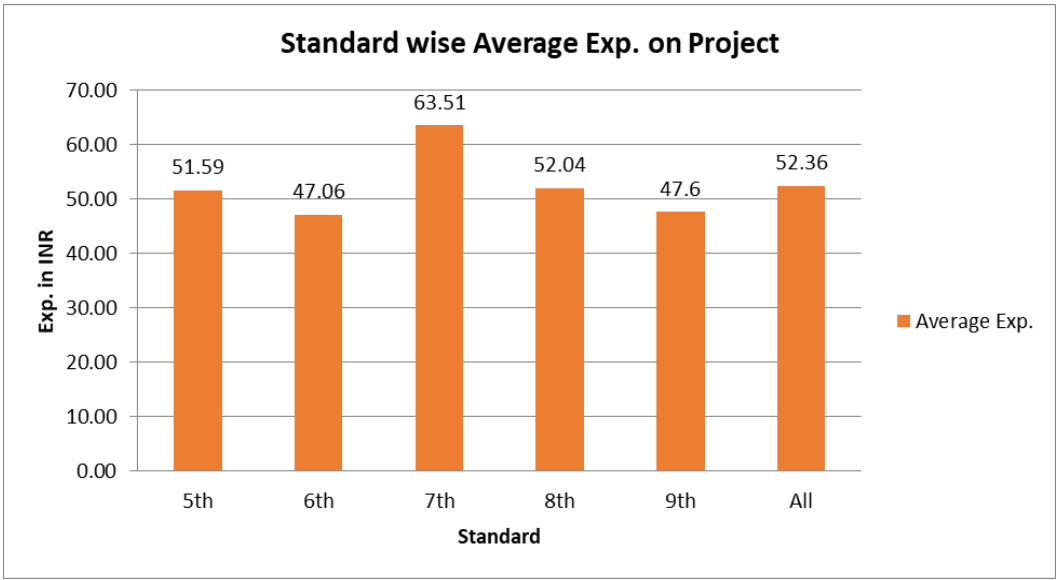


Diagram no.5

Students reported to spend average Rs.52.36 on school projects. It is important to note here that the students who participated in this study are from rural and remote regions including forested areas, and belonging to many disadvantaged communities. Expenditures in urban areas are in multiples of this figure. Even using this study sample result and considering that there are 2.28 crore (22.8 million) school students enrolled in Maharashtra[1], size of the school projects material market and burden on the parents is huge, over 119 crore rupees annually by the most conservative estimate. This calls for interventions towards quality improvements and access related issues by the State Education Department, including by engaging with private publishers in improving quality of learning materials.

[1] https://student.maharashtra.gov.in/stud_db/EducationSec/edusec_second_mis

5. Effectiveness of Shivar Feri and H-PBL approaches as assessed against the baseline 2016

In 2016 baseline was created with participation of 318 students while it was possible to do comparative study in 2019 with 103 students who went through learning process under MGB. Following table provides information on standard wise distribution of 2016 and 2019 students participation in the study.

Sr. No.	Classes (Std)	Baseline 2016	Baseline 2019
1	3rd	6	0
2	4th	18	2
3	5th	14	0
4	6th	11	0
5	7th	58	17
6	8th	69	16
7	9th	56	40
8	10th	17	16
9	11th	19	4
10	12th	10	4
11	Other	1	0
12	Std not written	39	4
	Total	**318**	**103**

Table no.6

For comparative study we randomly selected 17, 16 and 40 students of Std. 7, 8 and 9 respectively from 2016 sample to compare against 2019 students of same sample size.

Sr. No.	Classes (Std)	Baseline 2016	Baseline 2019
1	7th	17	17
2	8th	16	16
3	9th	40	40

Table no.7

Below presented is graphical representation of this comparative study.

5.1 Using google earth

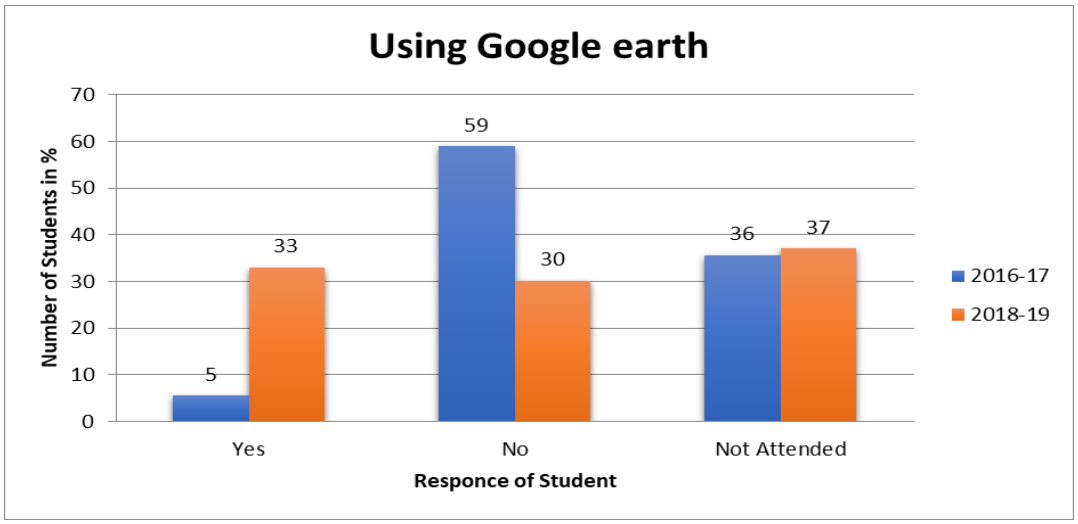


Diagram no.6: Familiarity of students with google earth went up from 5 to 33%.

5.2. Whether you have prepared school biodiversity register

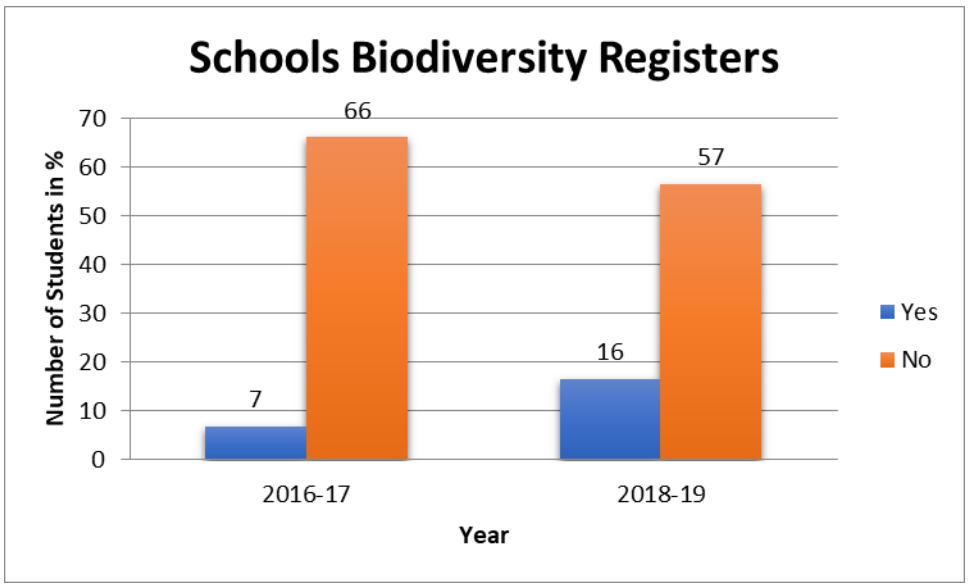


Diagram no.7: Change from 7% to 16% was much lower than anticipated change under the project and it emerged as a learning that while schools carried out Shivar-Feri enthusiastically and even repeatedly, meticulously documenting these in the register was not realized in absence of systemic incentives for schools and teachers. In present situation – significant external support is required to get schools prepare school biodiversity registers.

5.3 Basic Mathematical competency among the students: calculating rainwater harvesting potential of a hypothetical school roof of given dimension (110ft x 40ft) if rainfall was 890mm.

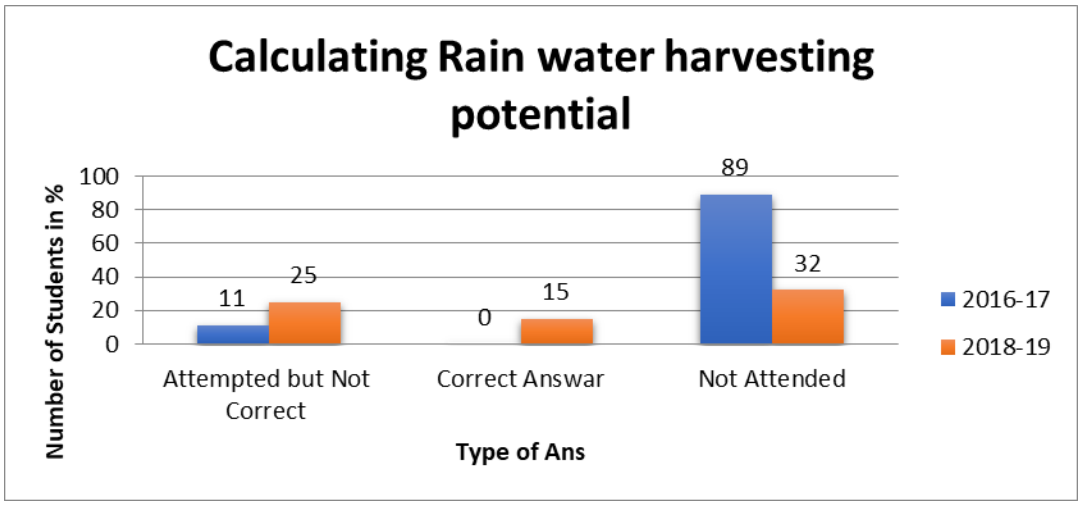


Diagram no.8: Poor basic mathematical competencies, at 7th grade such as calculating area, volume and conversion of units; prove limiting to effectively conduct environmental education activities using real-life problem-solving approach, which are inherently multi-

disciplinary. This was very clearly established during the baseline, which is in line with regular studies conducted by government and non-government agencies to assess learning levels for basic math and language. With this challenge learning approaches esp. habitat linked projects-based learning (HL-PBL) showed potential to be beneficial to improve basic subject competencies as well.

5.4 Measuring tree height using trigonometry

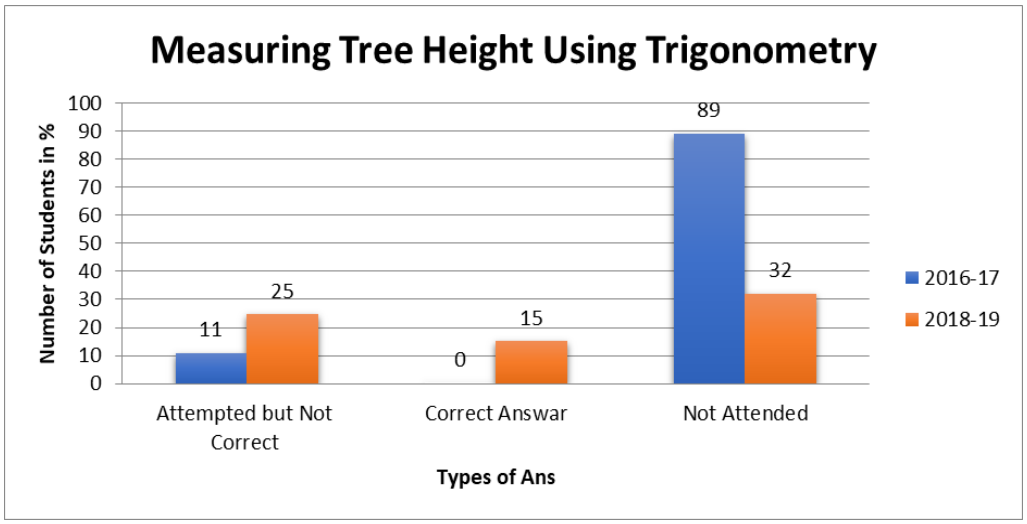


Diagram no.9

5.5 Name the trees you know

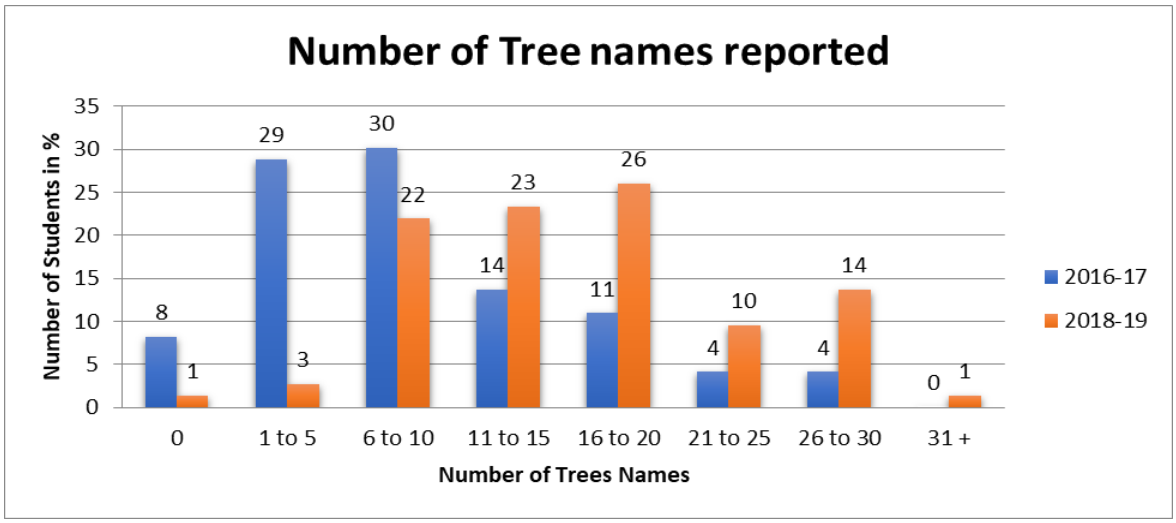


Diagram no.10: It is clearly evident that Shivar Feri and other learning activities are effective in improving learnings levels.

5.6 Raanmeva- Wild edible foods (Ready to eat without any processing)

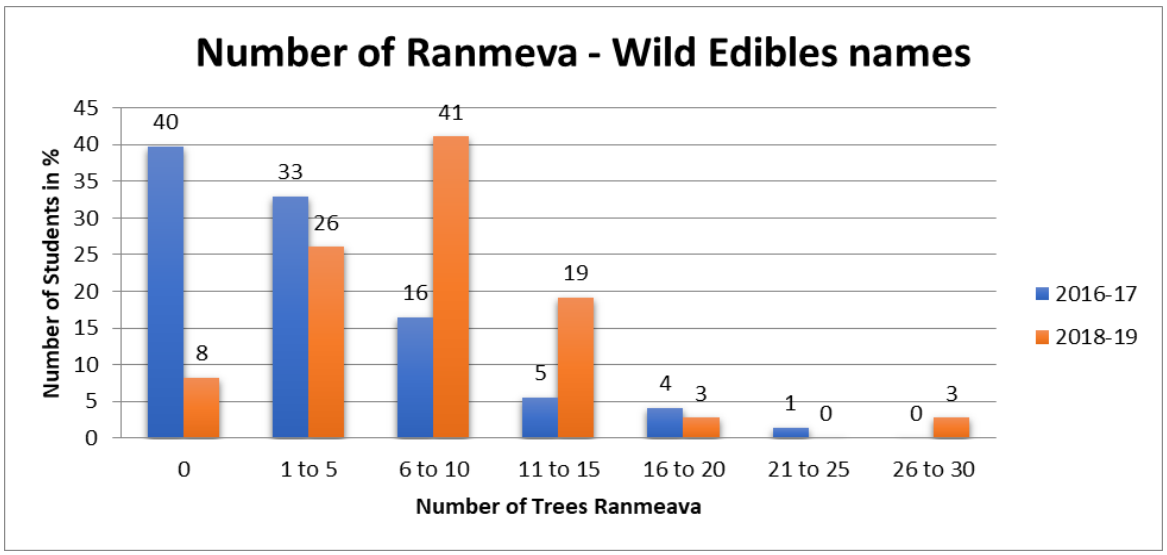


Diagram no.11: Largest number of students shifted positively from being able to tell up to 5 names to up to 10 names in 2019. Also, there is significant increase from baseline in 11-15 category. Ranmeva emerged as a significant topic for further work with student community in terms of botanical identification from over 130 local names generated, and nutritional analysis, communication and conservation actions.

5.7 Birds I know

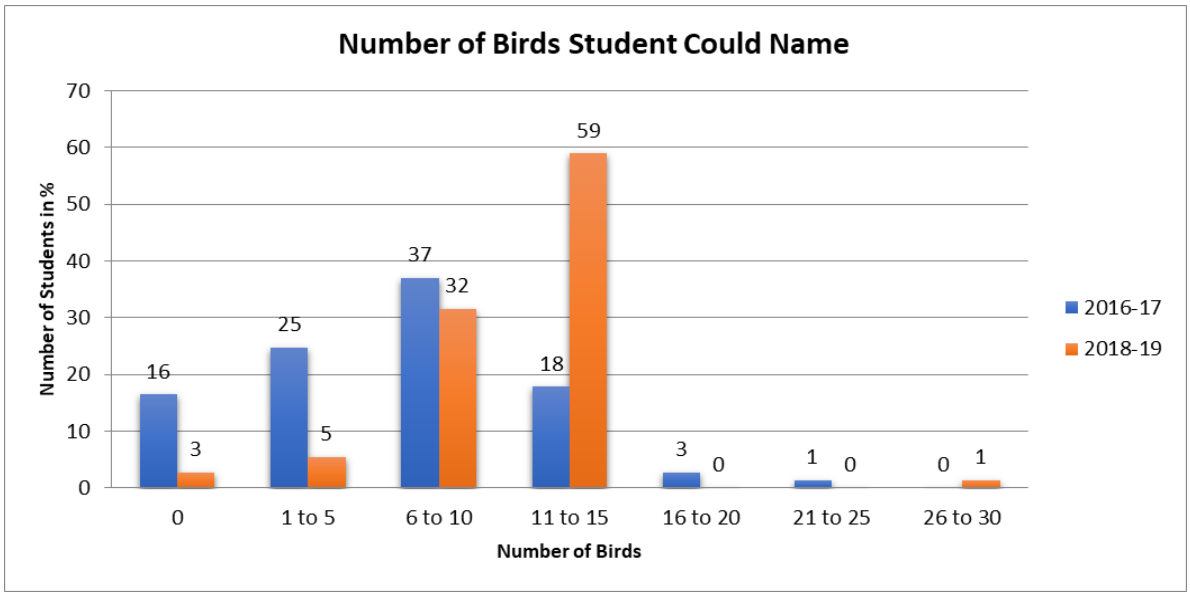


Diagram no.12

Bird watching was among popular activities conducted by schools during Shivar Feri, aided by field guides, binoculars and facilitation under MGB project. Impact of this is clearly evident in 59% students able to name 11 to 15 birds and one student reaching up to 26-30 category.

5.8 Butterflies I can name

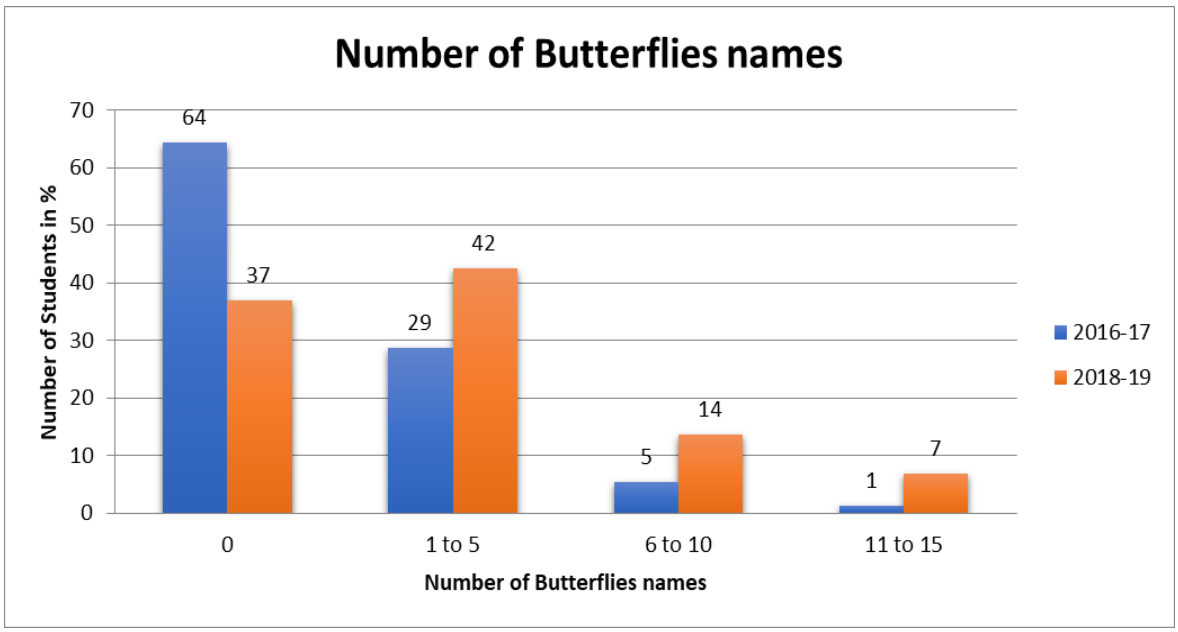


Diagram no.13: Butterflies and insect are among the groups with least local names available in any community setting, as reflected by majority of students not able to name any butterfly in 2016. With butterfly field pocket book developed and exploration activities in 2019 majority of the students could name 1 to 5 names and 7% naming 11-15 names.

5.9 Fish names

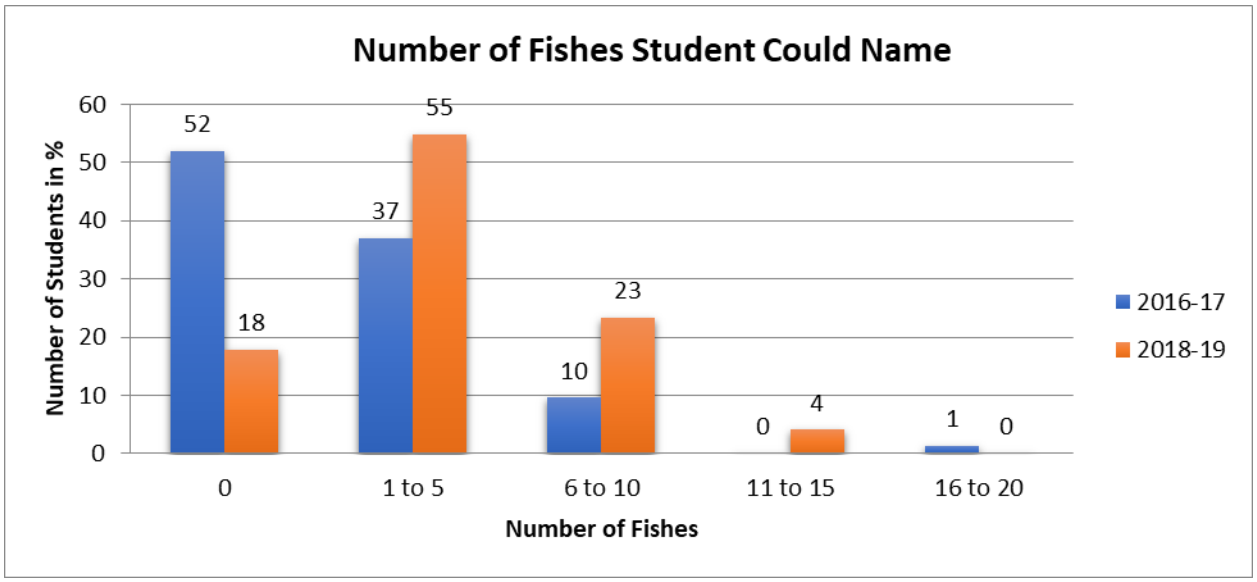


Diagram no.14: Similar improvement can be observed in case of fishes as well.

5.10 Situational questions to understand values and perceptions

5.10.1 Choice between comparatively low yielding local variety of Jowar and HYV

Question asked was: What would you choose between traditional/local variety yielding 800kg/acre and a hybrid variety yielding 1200kg/acre? And Why?

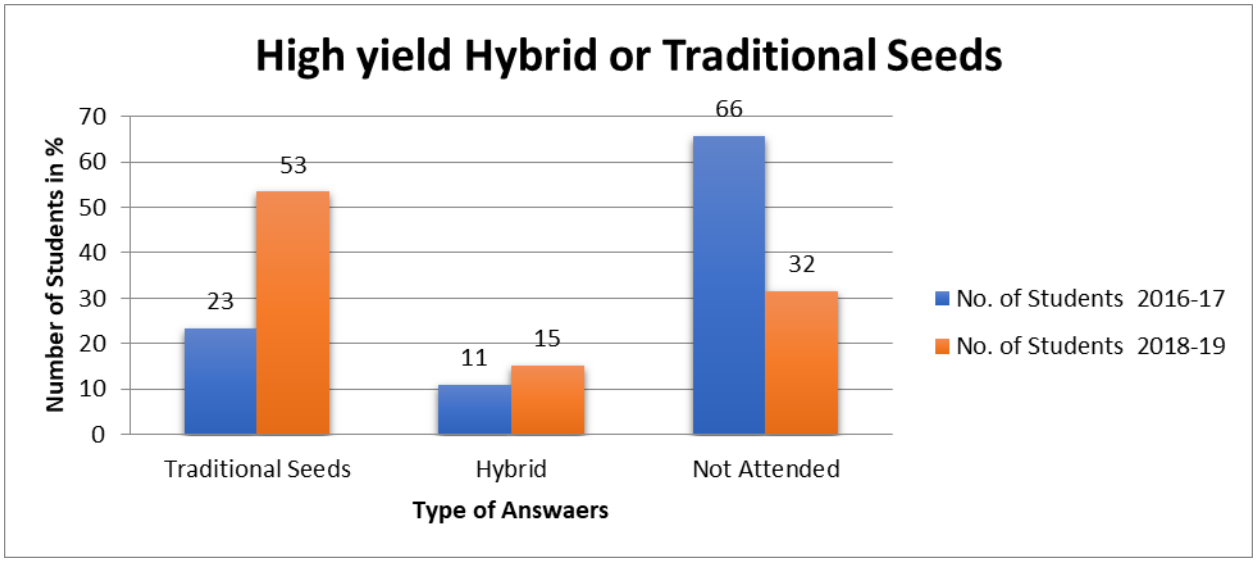


Diagram no.15: In 2019 students who responded to this question doubled

The reasoning provided for making these choices is summed up in below table

Choosing traditional/local variety	Choosing hybrid variety/HYV
Good for health, no need of fertilizer application, tasty and nutritious, high in nutritional value, fetches better price, hybrid food causes diseases	Yield is higher

Table no.8: This can be understood either as possibility of 'playing to the gallery' by the respondents or influence of recent buzz around traditional/local/organic food in various media. It also highlights the complex pathway towards desired change from appreciation of local and nutritious foods to changes in agricultural system. Consumers, markets and policies all play crucial role in bringing about this complex change.

5.10.2 Is it OK to pay higher wages to male workers than women for same work in the farms? Why?

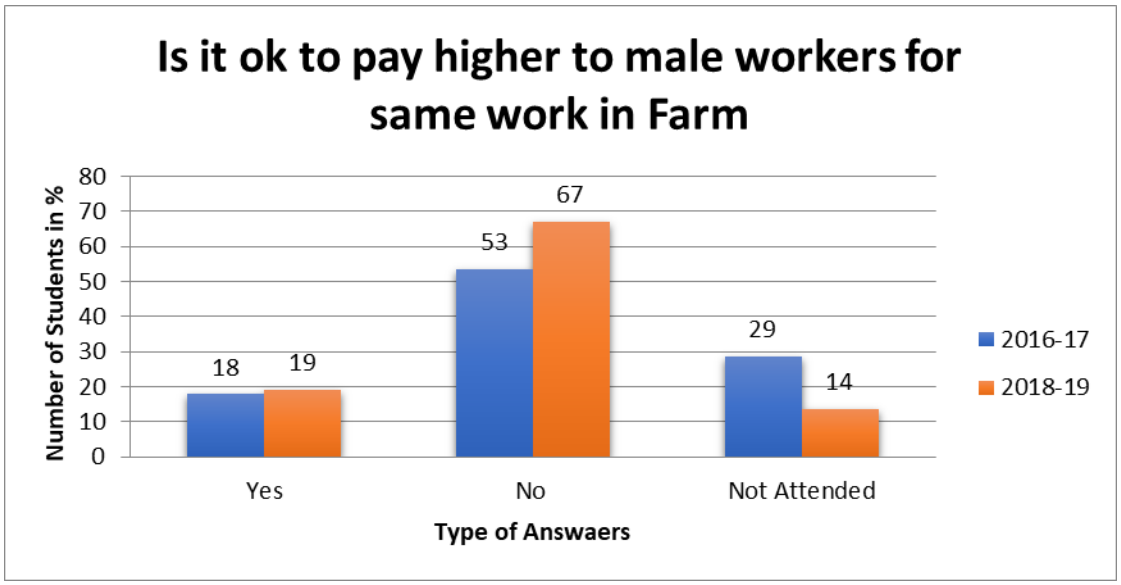


Diagram no.16: 2019 survey showed increase in those opining it as OK and not OK, though later increase is bigger. It is interesting to understand the reasonings provided and how learners contexts and prevailing social norms play an important role in shaping such values.

Below table summarizes the reasoning provided for both the opinions.

Not OK	OK
Women too work equally, there should be equality, same work-same wages, women should get more wages	Men work more, women work less, women waste time in chatting, men work more in same time, because wages depend upon quantum of work done.

Table no.9

Gender perspectives are still largely shaped by learners' family and immediate social norms and experiences. Schools need to critically engage with these issues and can play positive role in exploring complexities and developing sense of gender equality and of justice. This potential was demonstrated by two opinions expressed by students in 2016. First, a student opined that 'since agricultural produce do not get fair prices in market, farmers are unable to pay more/equitably', and another opined that 'if women generally came late to work on farms, and men earlier it was due to the fact that women have to take care of home chores like preparing food, while men did not. We should be considerate to this fact'.

6. Conclusions

In the context of present and future challenges related to food and nutrition, climate change and sustainability of human developmental process, bio-cultural diversity education offers potential both to enhance quality of learning process and development of new age competencies in the learners. A participatory designing process offers potential to develop an inclusive and better contextualized curriculum. Biocultural diversity learning by its very nature bring in multilingualism to the process and allows learners esp. from various disadvantaged groups to use their cultural capital in to formal learning process and achieve better academic performance.

It is important to prioritized learning centric approach to 'instrumentality' when it comes to school community's engagement with environment and sustainability challenges. It is a better way to build conservation actions based upon learnings and competence development than present treatment of students and teachers at large as 'free labor and photo-op crowd'. An action learning process instead can contribute to enrich our understanding with grassroots realities and support local actions, as demonstrated by wild food studies and local plants nursery development actions among others. These also provided with insights in to conservation priorities with much local status which formal science and research has limitations to provide.

Communities with their habitat and knowledge are an important resource to learn about biodiversity and associated cultural practices. This nascent partnership between schools as formal spaces and community-habitat as space for non-formal and informal learning is important to ensure intergenerational transfer of traditional and experiential knowledge and practices. It is only with competent teachers that it is possible to deal with biases, stereotypes and inequalities that may exist within communities and normative values, by engaging learners in a reflective exercise towards critical look at the reality as well as developing self-awareness in change management.

As experience under this project showed activities like School Biodiversity Register (SBR) development depends largely upon external facilitation and motivation given its complexity and in absence of any formal mandate as an educational method.

Basic subject competencies are a challenge in meaningful engagement with students and teachers in essentially multi-disciplinary learning activity as bio-cultural diversity education. Using this framework and approaches of Shivar Feri and Habitat linked Projects Based Learning (H-PBL) offers scope for developing basic subject competencies as well.

It was evident that teacher capacities are a key area of neglect esp. when it comes to developing understanding about constructivists methods of learning. Hands on experiential

training designs for teachers as in Anandshala Shibir modules proved effective in building teacher capacities as well as motivations. Teacher-students combined workshops proved effective as a collective learning approach and also helped in reinforcing school level activities and as a strategy to maintain continuance in eventuality of teacher transfers, from project management point of view as well.

It was also evident that availability and access to quality learning resources is critical, which is largely market driven at present when it comes to projects-based learning with significant economic burden and wastefulness of resources in absence of quality in design and development of these materials.

This calls for public investments in teacher capacity building and quality learning resource development and access, including by working with private publishers towards improving quality of learning resources available in the market. A participatory initiative like this with its repository of high-quality photographs on bio-cultural elements, tried tested project ideas bank, case stories from schools across the state and training modules can significantly contribute to better the textbook and associated learning resources development and teacher capacity building. Incidentally these approaches correspond well with key guiding principles of multi-disciplinarity and wholistic education, multilingualism, life skill development, respect for diversity and local context, rootedness and pride in Indian knowledge systems and traditions and inclusivity of education as articulated in National Education Policy 2020. Policy also mentioned need for special attention to eliminate disparities when it comes to Socially and Economically Disadvantaged Groups (SEDGs), and a more inclusive curriculum design, teachers' capacity building and improving access to quality learning resources enabling effective implementation of learners' habitat linked approaches are key recommendations emerging from this experience under Maharashtra Gene Bank Project.

Acknowledgement (if any)

Author would like to thank all the participating schools, students and teachers in this project. This was possible only with contributions by colleagues from IEC for Maharashtra Gene Bank project team at Centre for Environment Education, Pune namely Baswant Dhumane, Yuvraj Shingte, Abhijeet Kamble, in the entire project journey, in designing and conducting project activities; data entry and analysis work along with Shruti Kulkarni, Vrushali Kamble, Rajendra Shivgan, Priyanka Dharme and Shrirang Dhavle. State wide surveys and documentation were made possible by participation of team of Paryavaran Shikshan Mitra (environment education facilitators) working with partner organizations

namely, B.K. Gaikwad, Dattatrey Wadhekar, Eknath Bagul, Jageshwar Pal, Kiran Kakade, Meena Deore, Nandlal Meshram, Prashant Kasdekar, Pravin Yannawar, Punesh Pawara, Ravindra Garud, Rohidas Duga, Sahdeo Dahikar, Sahebrao Rathod, Sanjay Shendage, Santosh Agale, Vinod Ghodse. Ruchira Jadhav and Swati Kedar as interns contributed with survey activities and compiling school project resource material from market.

Author would like to extend sincere thanks to Rajiv Gandhi Science and Technology Commission, Govt. of Maharashtra for financial support to the project within which this work was carried out in close cooperation with partner organizations viz. BAIF, BNVSAM, GYPM, IIRD, Janarth, Khoj, Lok Panchayat, Lok Paryay, Sanskruti Samvardhan Mandal, Samvedana, Sheti Parivar Kalyan Sanstha, Ugam, Vasudha, Vrukshmitra and IISER, Pune for overall project coordination.

References

1. Awate, Satish and Kumbhar, Dhondiba (2014) Partnership for Preserving Bio-diversity and Culture. In Case Stories of Learning Partnerships for ESD, Asia Pacific Cultural Centre for UNESCO, Japan
2. Maffi, Luisa and Dilts, Ortixia (2014) Biocultural diversity toolkit, Volume 1 - Introduction to Biocultural Diversity, Terralingua (online pdf). Available at https://terralingua.org/wp-content/uploads/2018/09/Biocultural-Diversity-Toolkit_vol-1.pdf
3. Schreiber, Jörg Robert and Siege, Hannes (2016) Curriculum Framework Education for Sustainable Development, Engagement Global gGmbH, Bonn